

PHYSICIANS' STYLES OF PRACTICE†

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1. INTRODUCTION

Over the past twenty years the price of all goods and service has risen dramatically. However, the annual rate of increase of the consumer price index for health care services has consistently risen faster than the overall annual rate, and the health care sector's proportion of the gross national product continues to rise. In response to concerns about the increasing costs of health care, policy analysts have turned their attention to the economic impact of decisions made by physicians regarding the organization of their practice and the treatment of their patients.

In our present health care delivery system physicians are the gatekeepers of virtually every type of health care-related resource. This gatekeeper role is evidenced by physicians' economic success, and by society's profound trust in their capabilities and integrity. Societal trust in the physicians' decisions results in a special relationship between physicians and their patients. Furthermore, it allows physicians' discretionary latitude in determining the form of their production function (including what type of treatment is prescribed) and to some extent, the price of factors of production and hence the cost of output.

In past years when resources for health care services were relatively more abundant and care was less costly, the physician's agency role

simply implied procurement of the best available care. Little incentive existed for economic efficiency of health care provision. Now, mounting costs necessitate an intensified effort to gain insight into the practice decisions of physicians.

2. PROBLEMS ASSOCIATED WITH MODELLING PHYSICIANS' DECISIONS

Much research about the decisions made by physicians regarding the organization of their practice and the treatment of their patients consists of the specification and estimation of traditional microeconomic models of consumption, production and supply. However, efforts to model the physician's decisions as economic choices have not been notably successful; see, for example, Frenzel's comments on Evans'. (1976) attempts to unravel the inner workings of the "black box" of the physician's practice.

The driving force behind rational economic behavior is, of course, decision-making which reflects the efficient use of scarce resources. Individuals as consumers are assumed to make decisions based on their preferences, the resources at their disposal, and the constraints they face. One problem common to the specification of all behavioral models is to distinguish correctly between variables the individual treats as fixed and those he has some control over and can vary. For example, one must decide whether physicians are price setters or price

takers.¹ In econometric terminology, one must specify correctly the endogenous (dependent) variables and the exogenous (independent) variables. As the proportion of endogenous variables increases it generally becomes more difficult to identify and, therefore, to estimate the parameters. However, representing endogenous variables as exogenous variables will at least lead to inconsistent parameter estimates in ordinary least squares (OLS) regressions and at worst will result in incorrect causal inference, thus leading to misspecified policy alternatives. Consequently, variables must be designated correctly as endogenous or exogenous. In models of physician decision-making problems arise. The gatekeeper role of physicians means that they exert considerable control over many aspects of their environment; income, leisure, productivity and other aspects of the practice including characteristics of the patients are, to some extent, controllable by the individual physician and a change in one attribute may lead to a change in some of the others. Many variables are endogenous.

Inquiry into individual decision-making often involves the analysis of cross-sectional, non-experimental data and such data represent a formidable challenge to the assumptions underlying models derived from the traditional microeconomic paradigm. Specially, if one is to impart behavioral interpretations to relationships found among variables in cross-sectional data (such as a change in hours of labor supplied induced by a change in wages, or a change in consumption induced by a

¹ See the recent literature review by Juba (1979).

change in prices or income) one must be prepared to argue that individuals in the sample with similar resources make similar decisions when facing similar constraints. That is, their preferences and therefore their utility functions are similar. As Hausman and Wise (1978) state "(a) common procedure used in both economic and econometric theory is to assume the existence of a 'representative' or 'average' individual who is assumed to have tastes equal to the average (of) all decision makers with given observed attributes". The concept of a representative individual with certain observed attributes may be difficult to support if neither axiomatic theory nor previous empirical evidence suggests groups of individuals with relatively homogeneous preferences. Thus, failure to recognize heterogeneity in the population under study can introduce errors in specification and estimation of economic models.

A major purpose of this research is to reduce the errors inherent in previous economic models of physician behavior by identifying homogeneous groups of physicians for common analysis. At the same time we recognize that variables that characterize a group are highly interdependent.

3. MODELLING PHYSICIAN DECISIONS

A large number of variables are available to characterize the physician and his practice. We divide these variables into three groups:

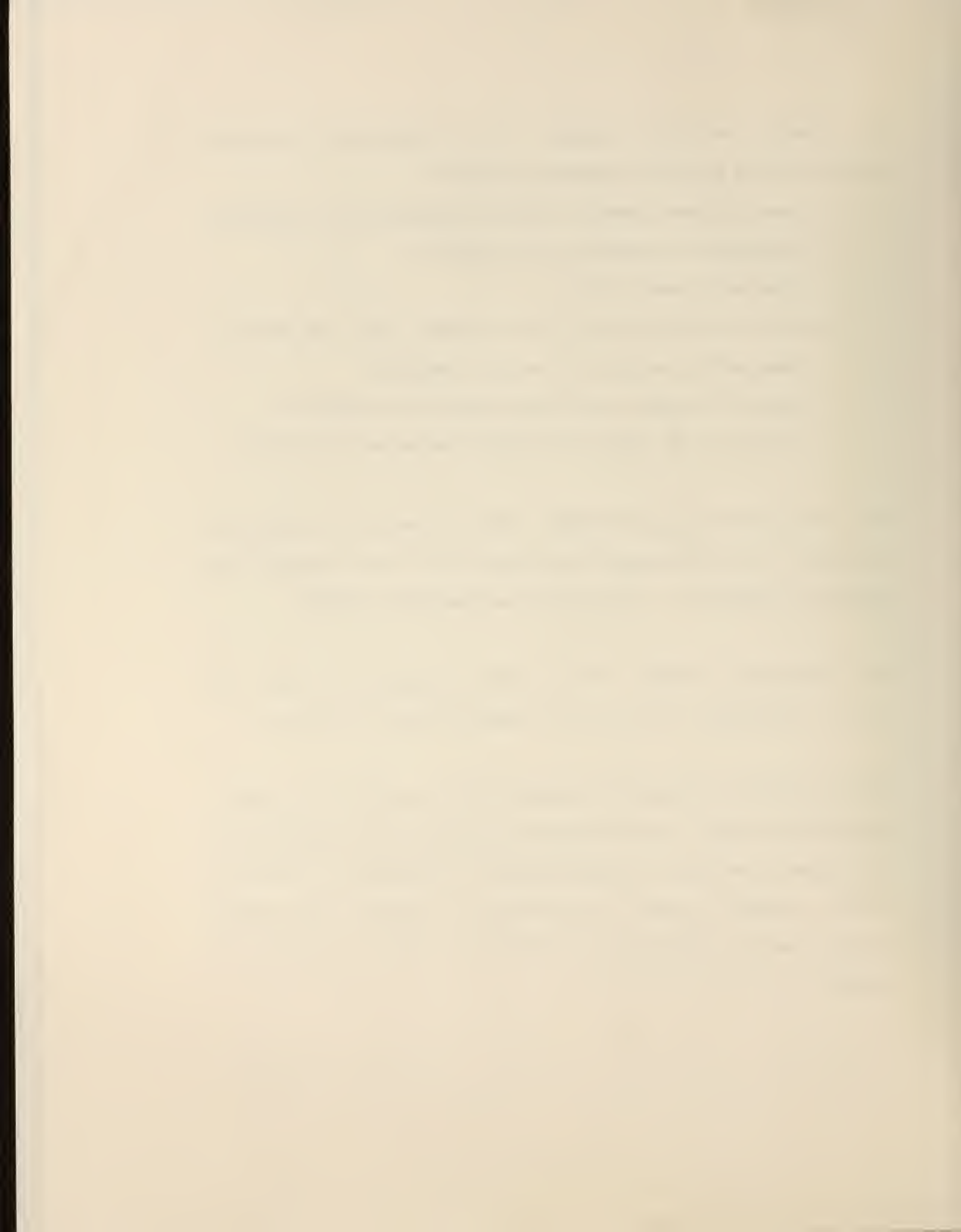
i) Practice attribute variables. In our empirical analyses we include in this group the following variables:

- a) number of hours worked by aides per physician in the practice,
- b) physician's net income from the practice,
- c) physician's level of fees,
- d) mix of patients seen by the physician, e.g. the patients' demographics and types of insurance coverage,
- e) number of patients seen per unit time by the physician,
- f) division of the physician's time across various activities.

ii) Early career choice variables. These include type of specialty, whether or not the physician is board certified, size of practice (the number of physicians in the practice) and geographic location.

iii) Exogenous variables. These include the physician's race, sex, years of experience, and income from sources outside the practice.

Thus, variables are grouped according to the ease with which a physician can vary them. The first group of variables are relatively easy to change at any time, the second group of variables are relatively hard to change soon after the physician has graduated from medical school, and the third group of variables are fixed at any point in time.



Our primary concern is the variables in the first group. The following discussion suggests three major simultaneous influences on the practice attribute variables: demand influences by patients, supply influences on the part of physicians, and technological constraints among the attributes themselves.

Consider first the supply influences and physicians' preferences. When discussing preferences for a bundle of commodities such as practice attribute variables it is useful to refer to the concept of a utility function that yields a value of "satisfaction" the individual derives from each bundle of commodities. Suppose that a physician's utility depends on income, y , and characteristics of the work environment, Q . While, in practice, Q will be multidimensional, let us consider only the leisure dimension. All physicians maximize their utility subject to a negative relationship between y and Q , which is analogous to a budget constraint in this example. In other models the constraints may be analogous to production possibility frontiers. The model becomes

$$\max U(y, Q) \quad (1)$$

$$\text{s.t. } y = f(Q) \quad (2)$$

where $\partial y / \partial Q < 0$. Now suppose there are two types of "representative" physicians whose utility functions, U_1 and U_2 , are drawn in Figure 1. In this case we would observe two types of physicians: (a) income preferring physicians who have high income and few leisure hours and (b) leisure preferring physicians who have low incomes but many leisure hours.



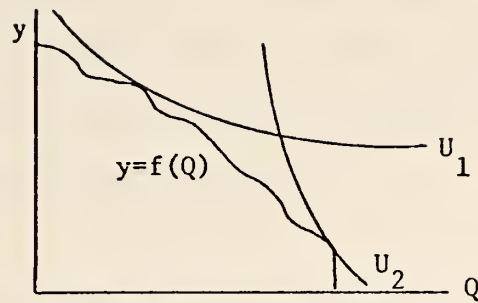


Figure 1

This simple example considers only two dimensions for the practice. In addition to income and leisure, legitimate arguments of the utility function include productivity, aides and patients' characteristics. Clearly, it is appropriate to allow for many types of physicians.

Of course, a physician does not have unrestricted control over all practice attributes. For example, a physician cannot work few hours, see few patients, have low fees and have a high net income from the medical practice. There are limits to the number of patients a physician can see per hour, the number of hours he can work per day, and the number of aides he can supervise effectively. These technological constraints apply to all physicians. They limit the number of types of behavior.

Whatever the particular set of attributes of a physician's practice may be, consumers of physicians' services have preferences over this set. If patients find a particular type of practice "unsatisfactory" they will, no doubt, seek an alternative type. Clearly, different patients have different needs and different utility functions. For

example, elderly patients with chronic illness may have quite different preferences from poor patients with recurrent, acute illnesses. These different preferences generate different demands for certain attributes of the physician's practice.

Just as a physician has a preference for a certain type of practice and type of patients, a patient has a preference for a certain type of practice. There is a "matching" between the needs and preferences of physicians and patients. The net effect of this matching process -- individual physician with individual patient -- is to create a number of what we refer to as equilibrium "styles" of practice. Since there are many practice attributes and since physicians' preferences differ and patients' preferences differ more than one type of style will be identified. Technological constraints, however, limit the number of styles.

The styles are determined as a result of aggregate physician and patient behavior. We propose first to identify the styles and second, treating the parameters of the styles as relatively fixed, to examine the adoption of a particular style by a particular physician. For this latter purpose we postulate and estimate a causal model which is represented in Figure 2. Basically, we suggest a two-stage process. Physicians first make early career decisions which concern primarily their type of specialty and geographic location. Subsequently, the physicians' styles of practice are adopted.

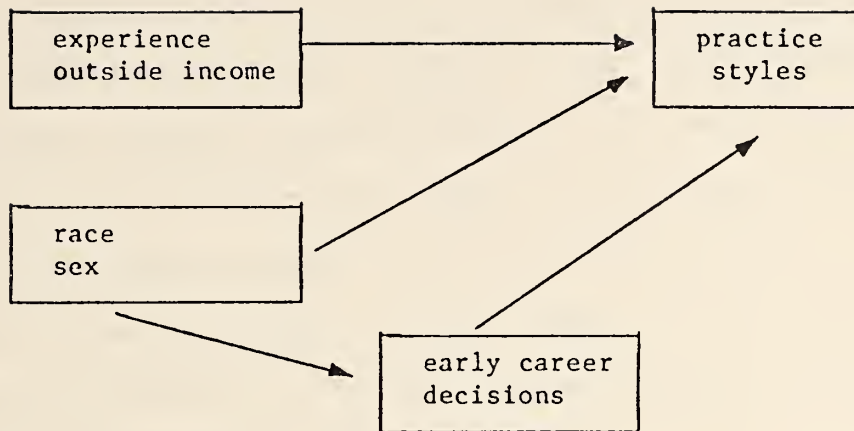


Figure 2: Outline of a Causal Model

Physicians choose a specialty while in training. Upon completion of training, their immediate concerns are geographic location and size of practice. Within this group of early career decision we also include board certification. While this decision is made after choice of specialty, it is usually made before and may affect the current practice attribute variables, which comprise the styles. These early career decisions are functions of a number of exogenous variables; among the set of potential exogenous variables we have data on physician's race and sex.

The early career choice decisions and all the exogeneous variables subsequently affect the style of practice. These relationships may be generated by simple axiomatic constraints (the patients of pediatricians are young), more complex constraints which have not achieved axiomatic status (patients of pediatricians tend to be uninsured for the treatment he provides) or they may reflect different resources and

tastes among physicians with different exogenous characteristics. For example, physicians with large incomes outside the practice may see fewer patients per week than may physicians with less outside income. Both types of physician may have a similar utility function; increased outside income simply expands the feasible set of choices. Despite differences among physicians we expect physicians who make similar early career decisions and who have similar values of the exogenous variables to adopt similar practice styles.

This model assumes that early career decisions, including choice of specialty, "cause" the practice attribute variables and there is no feedback from the practice attribute variables to choice of specialty. However, some physicians may elect a certain specialty because of the associated style of practice. Thus, one might postulate that anticipated practice style "causes" specialty. However, this is an insufficient justification to postulate a causal relationship from actual practice style to specialty.

The issue of timing of major career decisions by physicians has received little attention in the literature. However, a study by Wilson et al. (1979) suggests that for non-National Health Service Corps (NHSC) physicians eventual geographic location plans are made first, followed by practice community size, extent of involvement in patient care and eventual specialty. This temporal difference is most pronounced for non-primary care specialty fields (surgeons, psychiatrists, specialists in emergency medicine and other specialists), is

less pronounced for other primary care specialty fields (internal medicine, obstetrics, gynecology and pediatrics) and, for family practice specialists and general practitioners the decisions tend to occur close together. Their data indicate that upon graduation from medical school over seventy percent of the physicians have made an initial decision concerning geographic location and choice of specialty. The analysis by Wilson et al. suggests it is appropriate to postulate no causal relationship among geographic location, size of community, and specialty. One might also be inclined to include "professional activities" in this set and, in fact, Boardman et al. (1979) presents results containing no causal relationship among any of the early career or practice attribute. It is unlikely, however, that Wilson's definition of "professional activities" corresponds to the practice attribute variables and we feel justified in supposing that the latter variables are determined after the early career decisions. Nonetheless, the timing of physicians' major decisions requires further research.

4. RESULTS

a) Introduction

This section has two major purposes: to identify the practice styles and to estimate a causal model of the determinants of practice style. Section 4b discusses the attributes of each practice style. Section 4c presents formally the causal model in which we examine style choice, and section 4d discusses the results of the causal model.

For these purposes we use data from the 1975 Physicians' Administrative Practices Survey conducted by the National Opinion Research Center for the Health Care Financing Administration. This national survey yielded 460 observations for whom there were complete information on all relevant items. A description of each variable, the means and standard deviations appear in Table 1.

 Table 1 about here

b) Identification of practice styles

We have data on twelve major characteristics of practice attributes. The purpose of this analysis is to identify a number of styles which will reduce the rank of the matrix of the observations from twelve to a smaller number. Conceptually, the styles can be regarded as latent (unobserved) variables, with observed practice attribute variables as manifest indicators. The model can be written:

$$y_s = \Lambda_{y_s} \eta_s + \epsilon_s \quad (3)$$

where $y_s(p_s \times 1)$ is a vector of p_s observed practice attributes (in our case $p_s = 12$), $\Lambda_{y_s}(p_s \times m_s)$ is a matrix of factor loadings, $\eta_s(m_s \times 1)$ is a vector of m_s unobserved styles of practice (common factor variates) and $\epsilon_s(p_s \times 1)$ is a vector of specific factor variates (error). y_s and η_s are standardized to have zero mean and η_s has unit variance. In addition, $\theta_{\epsilon_s}^2$ the variance-covariance matrix of ϵ_s , is assumed to be diagonal.

In order to obtain estimates of Λ_{ys} one must specify a priori the number of factors or types of style to be extracted from the correlation matrix of practice attribute variables. Choosing the number of factors is not a simple task and, in the absence of definite a priori guidelines, the criteria for selecting the number of factors is the subject of some debate in the factor analysis literature. One criterion on which there seems to be general agreement is to include those factors with eigenvalues greater than unity. The eigenvalues of the correlation matrix represent the amount of variance in all the variables explained by particular factors. Choosing these factors with eigenvalues greater than unity assures the inclusion of all factors which explain as much variance in the attributes as any single variable. The eigenvalues for the correlation matrix of practice attributes in the 1975 data are shown in Table 2. The first five factors have eigenvalues which are greater than or equal to one. Also shown in Table 2 is the percent of variance in the practice attribute variables explained by each factor. The first five variables taken together explain 61.1 percent of the total variance.

 Table 2 about here

The loadings, Λ_{ys} , were estimated in two ways. First, we performed a principal components analysis and then subjected the results to a varimax rotation. The resultant varimax rotated factor loadings are

presented in Table 3. Second, to examine the stability of the findings we also performed a maximum likelihood factor analysis using LISREL and present the findings in Table 4.² All loadings in Table 3 above 0.4 and the corresponding loadings in Table 4 are underlined.

 Tables 3 and 4 about here

These tables identify five practice styles:

- (i) Busy, successful, ambulatory care practice. This style includes physicians who use many aide hours, see many patients, work long hours seeing patients and have high net incomes. Further research suggests that these physicians see most of their patients in the office rather than in hospitals or in other settings;
- (ii) Low-income practice. This style includes physicians who treat low income patients and Medicaid patients;
- (iii) Expensive, prosperous practice. This style includes physicians who charge high fees, see high income patients and have reasonably high net incomes;
- (iv) Geriatric, hospital practice. This style includes physicians who treat Medicare patients and patients with insurance. Further research suggests that these physicians see many patients and work long hours in hospitals rather than in the office or in other settings;

² See Jöreskog (1973).

(v) Academic or administrative practice. This style includes physicians who work many non-medical hours (administration) and many hours in other professional tasks, such as teaching and research.

c) Formulation of a causal model

This section specifies formally the causal model that is represented by Figure 2, the notation is identical to Jöreskog (1973).

Let $\eta' = (\eta_1, \dots, \eta_m)$ denote a random vector of m latent, true endogenous variables; these variables represent the types of practice style and the early career choice variables, including choice of specialty and geographic location. Let $\xi' = (\xi_1, \dots, \xi_n)$ denote a vector of n latent, true exogenous variables; these variables are our exogenous physician characteristics. These variables are related by an interdependent system of linear structural equations:

$$\beta\eta = \Gamma\xi + \zeta, \quad (4)$$

where $\beta(m \times m)$ and $\Gamma(n \times n)$ are parameter matrices and we employ the usual normalization of setting the diagonal elements of β equal to unity. $\zeta(m \times 1)$ is a random vector of disturbances (errors in equations) with $E(\zeta) = 0$. Without loss of generality we suppose that $\eta_i (i = 1, \dots, m)$ and $\xi_j (j = 1, \dots, n)$ are standardized to have zero mean. Further, we assume that β is nonsingular and ξ is uncorrelated with ζ .

As mentioned previously, the vector η is unobserved; instead we observe a vector of indicators $y(p \times 1)$ such that:

$$y = \Lambda_y \eta + \epsilon, \quad (5)$$

where $\Lambda_y(p \times m)$ is a matrix of loadings and $\epsilon(p \times 1)$ is a vector of measurement errors. $E(\epsilon) = 0$ and each element of ϵ is distributed independently of each element of η , ξ and ζ . Without loss of generality, each element of y has zero mean. In our application, the y variables are the observed characteristics of the physician's practice and the early career choice variables. We will assume the latter variables are measured without error.

The vector ξ is unobserved; instead we observe a vector of indicators $x(q \times 1)$ such that:

$$x = \Lambda_x \xi + \delta \quad (6)$$

where $\Lambda_x(q \times n)$ is a matrix of loadings and $\delta(q \times 1)$ is a vector of measurement errors. $E(\delta) = 0$ and each element of δ is distributed independently of each element of η , ξ , ζ and ϵ . Again, it is assumed that each element of x has zero mean.

Finally, $\Phi(n \times n)$ and $\Psi(m \times m)$ denote the variance-covariance matrices of ξ and ζ , respectively. The elements of Ψ provide a measure of goodness of fit. Since ζ_i denotes the error associated with equation i ($i = 1, \dots, m$), the goodness of fit of this equation is given by

$$\begin{aligned} R_i^2 &= 1 - \text{var}(\zeta_i) \\ R_i^2 &= 1 - \psi_{ii} \end{aligned} \quad (7)$$

where ψ_{ii} is the i th diagonal element of Ψ .³ $\theta^2(p \times p)$ and $\theta^2(q \times q)$ are diagonal matrices of error variances of y and x , respectively. These error variances provide a measure of how well the latent variables "explain" the observed values; the smaller the error variances, the better.

In the maximum likelihood models we assume that the vector of manifest (observable) variables $z = (y', x')'$ is distributed according to the multivariate normal.⁴

The model represented by Figure 2 is a block recursive model. There are two sets (blocks) of endogenous variables: five practice styles and ten early career choice variables. (See Table 1 for a description of these variables.) Suppose we partition η such that $\eta' = [\eta'_s \ \eta'_c]$ where $\eta_s(5 \times 1)$ denotes the vector of latent styles and $\eta_c(10 \times 1)$ denotes the vector of early career choice variables. Similarly, we partition y such that $y' = [y'_s \ y'_c]$ where $y_s(12 \times 1)$ is a vector of practice attribute variables and $y_c(10 \times 1)$ is a vector of early career choice variables. We assume that the early career choice variables are measured without error, $\eta_c = y_c$. Also we assume that the exogenous variables are measured without error, $\xi = x$. We can partition the exogenous variables such that $x' = [x'_s \ x'_c]$ where

³ Equation (5) assumes the variance of y equals unity, which obtains in our model since we input the correlation matrix.

⁴ The prime superscript denotes the transpose operator. All vectors without this operator are column vectors.

$x_s(2 \times 1)$ denotes the exogenous variables, race and sex, that directly affect the practice styles and early career choice variables, and $x_c(2 \times 1)$ denotes the exogenous variables, experience and over ten thousand dollars outside income, that directly affect the styles but do not affect the early career choice variables. Finally, $\zeta' = [\zeta'_s \ \zeta'_c]$ where $\zeta_s(5 \times 1)$ represents the errors in the practice style equations and $\zeta_c(10 \times 1)$ represents the errors in the early career choice equations. Now we can write the model depicted in Figure 2.

$$\begin{bmatrix} I_s & -\beta_{sc} \\ 0 & I_c \end{bmatrix} \begin{bmatrix} \eta_s \\ \eta_c \end{bmatrix} = \begin{bmatrix} \Gamma_{ss} & \Gamma_{sc} \\ 0 & \Gamma_{cc} \end{bmatrix} \begin{bmatrix} x_s \\ x_c \end{bmatrix} + \begin{bmatrix} \zeta_s \\ \zeta_c \end{bmatrix} \quad (8)$$

$$y_s = \Lambda_{y_s} \eta_s + \epsilon_s \quad (9)$$

where, $I_s(5 \times 5)$ and $I_c(10 \times 10)$ denote identity matrices,⁵ $\beta_{sc}(5 \times 10)$ represents the effects of the ten early career choice variables on each of the five practice studies, $\Gamma_{ss}(5 \times 2)$ represents the effects of experience and over ten thousand outside income on the styles, $\Gamma_{sc}(5 \times 2)$ and $\Gamma_{cc}(10 \times 2)$ represent the effects of race and sex on the practice styles and early career choice variables, respectively. Equation (9) is identical to equation (3).

Before we estimate the model we must determine which elements of the parameter matrices will be fixed and which will be free. We allow all

⁵ Practice styles are assumed to be causally unrelated to one another and the early career choice variables are assumed to be causally unrelated to one another.

elements of β_{sc} , Γ_{ss} , Γ_{sc} and Γ_{cc} to be free and these parameters will be estimated. The structure of Λ_{y_s} is taken from Table 3. All loadings in Table 3 larger than 0.4 in absolute value are set free in Λ_{y_s} and will be estimated. All loadings in Table 3 smaller than 0.4 in absolute value are fixed equal to zero. In most cases a manifest variable is an indicator of only one style; however, net income is an indicator of both styles i and iii.

This model was estimated in two ways, with the off-diagonal elements of Ψ , variance-covariance matrix of errors across equations, set equal to zero and with them free. We report the results obtained with off-diagonal elements set equal to zero because when these parameters are free, the results do not change substantially and in more complicated models, identification problems emerge. The results are standardized, such that the variance of each element of η equals unity. The variances of x and y also equal unity because the input consists of the correlation matrix.

d) Discussion of the Results

The results are reported in Table 5. Consider first Λ_{y_s} which appears in Table 5a. A comparison of this table with Table 3 shows considerable consistency. All loadings have the correct signs, although they are slightly smaller in absolute value than those in Table 3. Nonetheless, the elements of $\theta_{\epsilon_s}^2$ which indicate the amount of unexplained variance of each manifest variable are no higher, in general, in Table 5a than in Table 3. The major point is that the

1870-1871. The first year of the war, the Union army was defeated at the Battle of Bull Run. This was a major disaster for the Union, as it showed that the army was not prepared for a conventional war. The Union government was forced to raise more troops and to reorganize the army.

1872-1873. The second year of the war, the Union army was defeated at the Battle of Fredericksburg. This was another major disaster for the Union, as it showed that the army was still not prepared for a conventional war. The Union government was forced to raise more troops and to reorganize the army.

1874-1875. The third year of the war, the Union army was defeated at the Battle of Chancellorsville. This was another major disaster for the Union, as it showed that the army was still not prepared for a conventional war. The Union government was forced to raise more troops and to reorganize the army.

1876-1877. The fourth year of the war, the Union army was defeated at the Battle of Gettysburg. This was a major turning point in the war, as it showed that the Union army was now prepared for a conventional war. The Union government was able to raise more troops and to reorganize the army.

1878-1879. The fifth year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1880-1881. The sixth year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1882-1883. The seventh year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1884-1885. The eighth year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1886-1887. The ninth year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1888-1889. The tenth year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1890-1891. The eleventh year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

1892-1893. The twelfth year of the war, the Union army was defeated at the Battle of Appomattox. This was the final battle of the war, and it resulted in the surrender of the Confederate army. The Union government was able to raise more troops and to reorganize the army.

descriptions (attributes) of each style in the causal model are similar to those obtained from the rotated factor loadings in the previous section. We now focus on the determinants of each style.

 Table 5a about here

Table 5b contains the other structural form parameter matrices. β_{sc} measures the effects of early career choices on practice styles. Most relationships are consistent with what is generally known about physicians' practices. Pediatricians do not treat Medicare patients (with rare exceptions) which is confirmed by the large negative coefficient for pediatricians in the equation for geriatric, hospital based physicians - style iv. Internists, on the other hand, more often serve as consultants for complicated cases than other specialists and more often see patients with severe problems (Aiken et al., 1979). To the extent that the elderly have more severe problems than the young and require hospitalization more often, internists are more involved in the hospital care required by the elderly, and the coefficient for internists with a geriatric, hospital practice (style iv) is the highest coefficient observed. According to the coefficients, internists are also likely to have expensive, prosperous practices (style iii), perhaps explained by their patients' relatively complex, severe problems which require more time-consuming and intensive care, much of which is liberally paid for by Medicare and other insurance programs. This explanation is consistent with our finding of a negative coefficient for family practice physicians and general practitioners on this style. Aiken et al. (1979) find that these physicians see fewer severe cases and fewer elderly patients. An alternative, but less appealing

explanation for these results, is that affluent patients substitute internists for GP/family practice specialists.

 Table 5b about here

According to Girard et al. (1979) internists spend 30 percent of their professional time on teaching, research, administration and other professional activities besides patient care. Although comparable figures are not available for other specialists, this amount of non-patient care activity explains the relatively high coefficient for internists with an administrative practice (style v).

It is not as clear why there is a high coefficient for obstetrician-gynecologists with expensive, prosperous practices. One possible explanation is that most obstetrical patients are covered by non-Medicare insurance and, of course, one must remember that other variables, such as race and sex, are controlled for. A more plausible finding is that obstetricians-gynecologists are less likely to treat Medicare patients and to adopt style iv than any other style.

The distribution of the other specialty coefficients is consistent with what is known about these practices. Family practice physicians, general practitioners and pediatricians see relatively more patients in their offices (style i) than do internists and surgeons who concentrate more of their patient care activity in the hospital.

Neither board certification, the number of physicians in the practice, county income, the density of physicians nor the age of the population

was strongly related to any practice style. However, there are some interesting findings. Rural areas (few physicians per square mile) are mainly associated with styles i and iv, which were observed above to be associated primarily with family practice physicians and general practitioners. We also find that physicians in urban areas (many physicians per square mile) are more likely than rural physicians to adopt style v -- academic or administrative practices, which is expected. These results are supported by Wilson et al. (1979) and the coefficients for county income are also consistent with their findings. The major reason we included physicians per square mile was due to the work of Satterthwaite (1979) and Pauly and Satterthwaite (1979) who argue that, contrary to traditional economic intuition, fees increase as physicians per square mile increases. We do, in fact, observe a positive loading of physicians per square mile on style iii - high fee, high net income practices. It is not clear, however, that more physicians per square mile cause the fees of all physicians to rise. An alternative explanation consistent with our findings is that as physicians per square mile rise some physicians are more likely to adopt the high fee style; some physicians may switch from one style to style iii.

The gamma coefficients measure the direct effects of the exogenous variables on practice styles. These relationships are also consistent with what is generally known about physicians' practice characteristics. Physicians with large outside incomes are more likely to have expensive, prosperous practices (style iii) than to adopt any other

style. There are several possible explanations for this. Prosperous practices generate income which can be invested profitably outside the practice to generate additional income. Physicians who can rely on outside income to supplement their practice income can more easily restrict their practices to fewer patients and may possess more entrepreneurial drive needed to attract affluent patients and to run efficient practices.

Male physicians and less experienced (and thus younger) physicians are more likely to have busy, successful ambulatory care practices (style i). Sloan (1975) finds that female physicians have traditionally devoted less time to their practices than have male physicians and this probably explains why they are less well represented in this relatively active and time-consuming practice style. Similarly, Sloan (1975) finds that older, more experienced physicians restrict their practice activity which leads one to expect they also would be less well represented in this practice style.

There is a strong relationship between non-white physicians and practices characterized by low income and Medicaid patients (style ii). Our findings suggest that non-white physicians treat more low income patients (per physician) than do white physicians. If our assumptions are correct and exogenous variables such as race determine the choice of practice style, this means non-white physicians choose practices with low-income patients more often than do white physicians.

The effect of race and sex on the early career choice variables appear in Γ_{cc} . While the equations have poor fits, the table suggests that white physicians are more likely to become family practice - general practice specialists, surgeons or internists than to become pediatricians, obstetricians or gynecologists. Male physicians appear more likely to become family practice - general practice specialists or internists than to become surgeons, pediatricians, obstetricians or gynecologists. White physicians and male physicians are more likely to become board certified, to work in a large practice and to work in areas which have few physicians per square mile than are non-white physicians or female physicians.

The relatively large negative coefficient for white physicians on physicians per square mile indicates that minority physicians, on average, work in bigger cities than do white physicians. Thus, increasing the number of minority physicians may increase the proportion of physicians working in the inner city. We also find that female physicians are more likely to work in large cities than are male physicians; however, the coefficient is very small. Before any policy suggestions are made it is necessary to determine the characteristics and needs of the patients treated by minority and female physicians in large cities.

The model presented above is the structural form model. The parameters reflect the direct effect of a variable on an endogenous variable. The reduced form parameters measure the total effect of each

exogenous variable on each endogenous variable. The net effects of the exogenous variables (experience, over ten thousand dollars outside income, race and sex) on each style are reported in Table 6. A comparison of this table with the gamma matrices in Table 5b shows that the structural form parameters are very similar to the reduced form parameters and the indirect effects of the exogenous variables are negligible.

 Table 6 about here

The estimated variance of the errors in equations, Ψ , appear in Tables 5b and 6. A comparison of these tables shows that the inclusion of the intermediate choice variables significantly increases the explanatory power of the model, particularly for styles iii and iv whose R^2 increase by 0.36 and 0.60, respectively.

5. IMPLICATIONS FOR PUBLIC POLICY

In reviewing the research and legislative history regarding physician decision-making one discovers that a clear definition of "desirable" physician behavior is not easily identified, and may be non-existent. Several specific practice decision variables have been studied, but never in the context of a comprehensive statement of objectives regarding physician behavior. Reluctance to define desirable physician behavior may be attributed, in part, to lack of technical expertise outside of the medical sector required to assess accurately the quality of medical outcomes and procedures. Another reason may be

the realization that, given the number of practice variables under the physician's control, it may be difficult to manipulate one variable through legislation without causing unexpected, undesirable changes in others. Practice attributes are linked by a complex set of relationships. The concept of styles serves to reduce the degree of complexity to a more manageable level by identifying the various forms of physician behavior. Interestingly, some policy discussions involving physician behavior already focus on styles of practice which transcend single variables. The Medicaid "mill" is one example.

Second, the relationship of individual physician characteristics to practice styles may suggest appropriate policies for medical school admissions and state licensing boards. Certainly, it appears that increasing the number of minority physicians would increase the access of low-income and Medicaid patients to physician services. However, this finding may be due to structural constraints and it should be accepted with caution.

Third, the styles are interesting because they measure the sensitivity of physicians to incentive reimbursement and other cost containment strategies. Physicians who maintain expensive, prosperous practices (style iii) are strongly associated with neither Medicare nor Medicaid patients, and thus may be relatively impervious to incentives or penalties involving these two types of reimbursement. One would expect physicians practicing in low-income (style ii) and geriatric (style

iv) styles to be more sensitive to changes in these reimbursement policies, particularly since they treat relatively large proportion of Medicaid and Medicare patients, respectively, and they do not appear to have high net incomes.

Finally, we may consider the responses of physicians who practice in the various styles to other changes in their decision making environment. It seems plausible, for example, that physicians practicing in a busy, successful practice (style i) would exhibit a different labor supply response to changes in fees or wage of aides than physicians practicing in an expensive, prosperous style where fewer patients are seen per day or per week. On the production side, one might find that physicians of one style are able to make more efficient use of clerical or clinical aides than physicians of another style.

6. SUMMARY

The process by which physicians make decisions concerning the organization of their practice is not well understood, despite intensive research efforts in the last decade. Established theories, such as those stemming from microeconomics, provide models of consumption, production, and supply decisions. However, when tested empirically, these models have limited ability to predict individual physician behavior.

In this paper we have attempted to initiate a new line of inquiry into the ways in which physicians make decisions about their practices. We have considered the possibility that significant differences in preferences over bundles of practice attributes exist among groups of physicians. Retaining the economic concept of decisions based on consumer and producer preferences, resources, and technological constraints, we developed an alternative model. We have described the physician's practice using variables which represent inputs to production of services, output prices and outputs themselves. We then examined the decisions that physicians make, looking for evidence of underlying structure or mechanisms which generate the observed data.

We have identified five latent characteristics of practices which we refer to as "styles" of practice. These do not represent discrete choices on the part of the physician. Physicians do not choose style i instead of style ii. Rather, we think of physicians as choosing a style which is, for example, strongly characteristic of style i or style ii or both, and not strongly characteristic of style iii. Styles may be thought of as characteristics of the practice which transcend single attributes. These styles appear to be useful in their ability to explain the variance in the attribute variables and they correspond to intuitively appealing concepts of practice style which have arisen from previous research and empirical observation. Boardman et al. (1979) found that the styles are robust when subjected to validation using the 1976 Physicians Administrative Practices Survey.

Our next step was to investigate the mechanisms which generate the styles of practice. We posited a causal model in which practice styles were functions of previous career decisions by the physicians and exogenous factors such as the physician's age, sex, and experience. These findings were discussed in the previous section.

Several extensions of this research are warranted. First, practice styles may be strongly influenced by combinations of previous choice variables, such as the choice of specialty combined with the choice of geographic location or size of practice. One simple improvement in our causal model would be the addition of interaction terms representing combinations of previous choices. Second, one might argue that, in addition to the effect of specialties on actual practice style, the anticipated style of practice may influence specialty choice. However, panel data are necessary to test this additional hypothesis.

Finally, we intend to use the results from this paper to examine the determination of individual practice attribute variables. Using the results from this paper we intend to classify physicians into five groups according to which style describes them best. For each group we will then estimate physicians' labor supply equations, production functions and demand equations for practice input variables.

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TABLE 1: DESCRIPTION OF THE VARIABLES, MEANS AND STANDARD DEVIATIONS

<u>Variable Name</u>	<u>Mean (S.D.)</u>	<u>Description</u>
Practice Attribute Variables (y_s):		
AIDHRMD	2.39 (1.56)	Number of hours worked by non-physician employees in the past week divided by the number of physicians (SIZE)
NETINC	54902. (28761.)	Physician's net income from the practice in 1975
FEEOFF	12.31 (4.37)	Physician's current usual fee for a follow-up visit in the office
HIINC	18.20 (18.56)	Percentage of patients with high family incomes
LOWINC	22.53 (21.22)	Percentage of patients with low family incomes
NOINS	12.87 (16.17)	Percentage of patients with no insurance
MDCARE	23.37 (20.4)	Percentage of patients covered by Medicare
MDCAID	11.56 (14.98)	Percentage of patients covered by Medicaid
NUMBER	163.97 (84.56)	Number of patients seen on hospital rounds, in the office, on housecalls, in emergency rooms, out patient clinics, in nursing homes and the number of operations and assists in the last seven days
MEDHRS	51.68 (16.68)	Hours spent on hospital rounds, in the office seeing patients, on housecalls, in emergency rooms, in outpatient clinics, in nursing homes and on operations and assists in the last seven days
NONMHRS	6.42 (6.42)	Total hours during previous seven days spent on: filling out health insurance forms, billing patients, personnel matters, general financial matters, hospital administration, and administration of own practice

PROFHRS	8.32 (6.02)	Hours devoted to other professional activities including reading, writing, research, teaching, and medical meetings in last seven days
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Early Career Choice Variables (y_c):

FAMGP	0.34 (0.47)	General/family practice specialty
SURGERY	0.15 (0.36)	General surgery specialty
PEDTRCS	0.13 (0.34)	Pediatrics specialty
OBGYN	0.14 (0.35)	Obstetrics/gynecology specialty
INTRNST	0.24 (0.43)	Internal medicine specialty
BCERT	0.45 (0.50)	Primary specialty boards; yes = 1, otherwise = 0
SIZE	1.84 (1.71)	Number of physicians associated with the office at least 20 hours per week
CNTYINC	4514. (8.39)	Average per capita income in the county (1970)
PHYSSQM	17.84 (77.20)	Physicians per square mile (1975)
AGED	0.09 (0.02)	Percent of population over age 65 (1970)

Exogenous Variables:

OVERIO	0.19 (0.39)	Physician and spouse have outside income in excess of \$10,000 = 1, otherwise = 0
WHITE	0.95 (0.22)	Physician's race; white = 1, otherwise = 0
MALE	0.93 (0.25)	Physician's sex; male = 1, female = 0
EXPER	22.70 (11.73)	Experience; 1975 minus the year the physician was licensed

TABLE 2: PERCENTAGE OF VARIANCE EXPLAINED BY EACH FACTOR

<u>Factor</u>	<u>Eigenvalue</u>	<u>Pct of Var</u>	<u>Cum Pct</u>
1	2.04	17.0	17.0
2	1.69	14.1	31.1
3	1.38	11.5	42.6
4	1.19	9.9	52.4
5	1.04	8.7	61.1
6	0.88	7.3	68.5
7	0.85	7.1	75.6
8	0.76	6.3	81.9
9	0.65	5.4	87.3
10	0.57	4.8	92.1
11	0.52	4.3	96.4
12	0.43	3.6	100.0

TABLE 3: VARIMAX ROTATED FACTOR MATRIX OF PRACTICE ATTRIBUTE VARIABLES

	<u>Style</u>				
	(i)	(ii)	(iii)	(iv)	(v)
AIDHRMD	<u>.704</u>	-.063	.074	-.044	-.107
NETINC	<u>.605</u>	-.066	<u>.426</u>	.027	-.196
FEEOFF	-.023	.042	<u>.813</u>	.077	.033
HIINC	-.043	-.224	<u>.603</u>	-.047	.058
LOWINC	.049	<u>.832</u>	-.058	-.079	.079
NOINS	-.051	-.064	-.091	<u>-.771</u>	.156
MDCARE	-.064	-.083	-.049	<u>.765</u>	.191
MDCAID	.001	<u>.850</u>	-.071	.060	-.025
NUMBER	<u>.784</u>	.112	-.212	-.141	.038
MEDHRS	<u>.710</u>	.085	-.138	.162	.172
NONMHRS	.022	-.014	-.018	.003	<u>.866</u>
PROFHRS	-.065	.109	.395	.035	<u>.465</u>

TABLE 4: MAXIMUM LIKELIHOOD FACTOR ANALYSIS LOADINGS

	<u>Style</u>					$\theta_{\epsilon_s}^2$
	(i)	(ii)	(iii)	(iv)	(v)	
AIDHRMD	<u>.540</u>	-.046	.025	-.028	-.077	.835
NETINC	<u>.504</u>	-.081	<u>.347</u>	.047	-.147	.770
FEEOFF	-.001	.005	<u>.712</u>	.087	.077	.687
HIINC	.045	-.151	<u>.293</u>	.030	.157	.929
LOWINC	.044	<u>.559</u>	-.099	-.048	.045	.820
NOINS	-.056	.006	-.035	<u>-.480</u>	.008	.876
MDCARE	-.051	.014	.034	<u>.519</u>	.077	.848
MDCAID	.039	<u>.570</u>	-.027	.067	-.064	.815
NUMBER	<u>.763</u>	.110	-.196	-.140	.036	.597
MEDHRS	<u>.567</u>	.131	-.103	.118	.070	.794
NONMHRS	-.016	.047	.030	-.006	<u>.404</u>	.914
PROFHRS	-.054	-.036	.111	.044	<u>.316</u>	.941

$$\chi^2 = 16.35$$

TABLE 5a: LAMBDA y (λ_{ys}) FOR CAUSAL MODEL

	<u>Style</u>					$\theta_{\epsilon_s}^2$
	(i)	(ii)	(iii)	(iv)	(v)	
AIDHRMD	.573					.820
NETINC	.506		.487			.760
FEEOFF			.619			.787
HIINC			.365			.934
LOWINC		.625				.774
NOINS				-.320		.951
MDCARE				.854		.556
MDCAID		.512				.865
NUMBER	.750					.661
MEDHRS	.548					.837
NONMHRS					.392	.921
PROFHRS					.413	.916

TABLE 6: REDUCED FORM PARAMETERS

<u>Style</u>	<u>EXPER</u>	<u>OVER10</u>	<u>WHITE</u>	<u>MALE</u>	<u>Y</u>
(i)	-.247	.005	.025	.229	.888
(ii)	-.023	-.001	-.417	.118	.817
(iii)	-.132	.368	.067	.042	.863
(iv)	-.042	.156	.054	.115	.961
(v)	-.034	.022	-.113	.046	.984

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